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SOME
EARLY TREATISES
ON
TECHNOLOGICAL CHEMISTRY.

BY
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Some early Treatises on Technological Chemistry. By JOHN
FERGUSON, M.A., Professor of Chemistry in the University of
Glasgow.

[Read before the Society, January 6, 1886.]

§ 1.—During the sixteenth, seventeenth, and eighteenth centuries there was produced a considerable number of books dealing with the marvels of nature, with popular science and medicine, and with practical receipts for domestic and workshop use, which went under the common title of “secrets.” Elsewhere* I have enumerated some 300 of these, which have come under my notice from time to time, and have endeavoured to show that they are possessed of different degrees of merit, both as concerns their contents and themselves. Among them there are upwards of a score which, though published under different names, in different languages, and at different times, exhibit such close relationship to each other that they are obviously variations and extensions of one work. They are practically unknown to bibliographers and to the historians of chemistry, and there is nothing more than a hint existing as to their origin and authorship. Although I have mentioned most of them in the papers referred to, I have not exhausted what may be said about them, and I propose in the following to give a list of them in chronological order, and such descriptions as may exhibit their history and connection with one another. I have tried to make the list as complete as possible, but I do not doubt that there are editions of some of the forms of the collection which have escaped me. If it be so they must be even scarcer than those now described, all of which, the earlier editions especially, have been most difficult to procure for examination.

§ 2.—

1.—1531. Rechter Gebrauch d' | Alchimei, Mitt vil biss her verborgen,
nutzbaren vnnd | lustigen Künsten, Nit allein den fürwitzigen

* In my *Bibliographical Notes on Histories of Inventions and Books of Secrets*, communicated to the Archaeological Society of Glasgow, and printed in their *Transactions* for 1883 and 1885. The present notes may be regarded as a supplement to these papers.

Alchimis- | misten (*sic*), Sonder allen kunstbaren Werckleutten, | in
vnd ausserhalb feurs, Auch sunst aller | menglichen inn vil wege
zuge- | brauchen. | ☞ Die Character, Figürliche bedeutungen, vnd
namen der Me | tall, Corpus vnd Spiritus. | ☞ Der Alchymistischen
verlateineten wörter ausslegung. | ☞ Register am folgenden blat. |

Small 4to, ff. xxvii, and one blank. Type of a somewhat florid kind is used for the title-page. Without place and printer's name. The date: M.D.XXXI. is on f. xxvii. verso. There is a vignette of a jeweller's shop on the title. On the reverse of the title are the symbols and names of the metals, &c., a list of certain Latin alchemical words, with their meanings, and the beginning of the table of contents, which ends on the reverse of f. ii. The text begins on f. iii., and runs on to f. xxvii. The first receipt is how to make imitation amber: *Agatsteyn zumachen artlich vnd klar*, and the last to refine gold: *Wie sich das golt gradirt*.

This is the earliest edition of the collection that I have seen, and I judge it to be the first, because I have found no reference to any one before it, and because it contains less matter than any of its successors. The book is not mentioned by any authority except Schmieder,* who says that it was written by George Agricola, the metallurgist, and that it was printed at Cologne, but there is no evidence in support of these statements in the book itself, and both of them are very questionable, if not demonstrably erroneous.

As to the place of printing. Two years later, in 1533, Christian Egenolph, at Frankfurt-am-Main, printed a little tract of 39 leaves, entitled: *Bergwerck vnd Probirbüchlin*, including Gilbertus Cardinal on solution and parting of the metals, to be noticed below in connection with Kertzenmacher. On f. 32 of this tract there is the *identical* woodcut of a jeweller's shop—not a mere copy—which forms the vignette of the present treatise. Further, the *Bergwerck...büchlin* contains woodcuts of a muffle and furnace for assaying which were used over again in 1574, by the heirs of Christian Egenolph, for a book entitled *Probier Büchlein*. Now, in the preface to this latter work, and the head-line of each page, the same florid type is used as in the title-page of the 1531 edition. I have no hesitation in inferring from these coincidences that this first edition was printed by Egenolph at Frankfurt. Later editions (Nos. 7 and 11) were printed by Egenolph and his heirs, as well as an edition of Kertzenmacher, in 1574 (No. 12), which is uniform with the *Probier Büchlein* of the same year, above mentioned, and which contains the same florid type.

* *Geschichte der Alchemie*, Halle, 1832, p. 270.

As to Agricola's authorship. Schmieder states that in his youth Agricola, who from his love of knowledge acquired the name of *Philopeustes*, had pursued alchemy and had written some treatises on it, which were sought for after he had distinguished himself in other ways, and then he gives the names of the said treatises, of which the *Rechter Gebrauch d'Alchimei* is one, and the other is entitled: *Galerazeya sive revelator secretorum*, I. *De lapide philosophico*,....printed, Schmieder says, in 1531 and 1534, dates already given by Dufresnoy (*Histoire de la Philosophie Hermétique*, Paris, 1742, III., p. 82), who has also assigned the *Galerazeya* to George Agricola. Schmieder's account seems to me to be purely imaginative. No one who has written about Agricola has mentioned these treatises, and they are not contained in the collected editions of his works; the *Rechter Gebrauch* was published long before Agricola's best-known works appeared, whereas the *Galerazeya*, at least the copy of it which I have seen, was printed at Cologne in 1631, not 1531. Further, the *Rechter Gebrauch*, as will appear from the abstract following, is a collection of practical receipts, whereas the *Galerazeya* has absolutely nothing to do with alchemy, but is a book of Roman Catholic controversy. The author was a certain *Daniel Agricola, Philopistius*, not *Philopeustes*, who lived to the comfortable age of 110 years, and whose whole life, as recorded in the introduction, does not tally at all with that of George Agricola the miner, metallurgist, and geologist. I have no doubt that Schmieder never saw a copy of the *Galerazeya*, but simply followed Dufresnoy. It is not so easy to understand what led him to credit Agricola with the *Rechter Gebrauch*. There is no indication of his being the author that I am aware of, and Schmieder has not noticed that a difficulty arises from the work of Kertzenmacher (which he himself has quoted [p. 280], and which I have included in the present series), having a similar title. Was Kertzenmacher the author of this first edition? In the meantime the author of it is unknown.

The contents of the book itself are entirely practical, and have little or nothing to do with speculative or transcendental alchemy. In this respect it is very remarkable that the author, whoever he was, should have affirmed, in the very title of his work, that the *right use of Alchemy* was not solely to transmute the metals, but to produce, by chemical art, different substances that were in constant demand for every day purposes, and to enable work-people and artists to compass their ends more easily and

successfully. The work is a collection of chemical receipts, which, doubtless, had been long and well-known to alchemists, metallurgists, and others, but which may never have been reduced to a system. Anyhow, the existence of this and the later editions shows that, untrammelled by the unconfirmed theories of the alchemists, there was a desire to turn their incidental discoveries to some useful purpose. Apparently, anything that was worth, any process that would yield a definite result, was taken advantage of, and by degrees came to be widely known, and to form the common property of artists of different kinds, and to be placed in books of receipts and secrets.

A characteristic of this and the other books of the series is the absence of concealment under misleading names of the substances to be used and the processes to be followed. The alchemist was always at great pains to withhold the secrets of his art from those deemed ignorant and unworthy, and he was in the habit of expressing himself in an allegorical and enigmatical style, which is one of the chief obstacles to understanding what the alchemists would be at. In this book, however, there is nothing of the kind, and if there is obscurity occasionally, it is due less to the language employed than to the difficulty of identifying the bodies mentioned, or of seeing precisely what is the drift of the operation described.

This book exhibits very fairly the practical knowledge of chemistry at the beginning of the sixteenth century. Many of the processes seem very roundabout and even absurd now, but then they were the best to be had, and it must be remembered that three and a half centuries have elapsed from the date of the book which records them, centuries filled with research into the causes of the changes which at that time were only slightly known after the most tentative fashion.

The receipts are not arranged in any regular way, but for our present purpose it may suffice to consider very briefly the contents of the book under two main heads: A. substances, and B. processes.

A.—The substances which bulk most largely in the receipts are naturally the metals and some metallic compounds. Gold and silver, mercury, antimony, tin, lead, bismuth, copper and iron are commonly spoken about. Brass was made from copper and calamine; amalgams of gold and silver were familiar, and the solvent power of mercury for these metals was employed for removing them from the others, as well as for getting calx of gold, that is, gold in a fine state of division. The parting of gold

from copper by antimony and by liquation with lead, the cementation and cupellation of gold, the separation of gold by aquafortis were all operations well-known at the time. Other operations were used for silver.

Gilding and silvering were largely practised, and the giving of a yellow and white appearance to other metals without the use of either gold and silver was often employed. But the method of distinguishing between true and imitation gold by streak and aquafortis is described also.

Mercury was much employed for the purposes above mentioned. Cinnabar was made from it artificially by heating it with sulphur; and sublimate is also referred to.

Copper was quite familiar. Besides being gilt, silvered, and tinned, it was converted into verdigris by acetic acid, from which a green colour was obtained; by the action of calamine it was made into brass; it was whitened by treatment with arsenic.

Lead was used in cupellation and liquation; it was converted into white lead by the action of acetic acid, and the process closely resembled that pursued at the present day; red lead was made by heating it in a furnace; and the so-called *lac virginis* was made by digesting litharge got in cupellation with acetic acid.

Tin was used chiefly for coating other metals and for alloying.

Bismuth is mentioned; a fusible alloy was employed for making casts; it was got by melting together lead, tin, and bismuth. This therefore is a very old alloy.

Of the compounds of iron, green vitriol and crocus martis are mentioned, as well as the red solution of ferric acetate.

Antimony is only mentioned in connection with the purification of gold.

White arsenic, orpiment, and realgar, are referred to. Arsenic was used for whitening copper. It was fused with saltpetre, and the residue (consisting mainly of potassic arseniate) was called *fixed arsenic*. A solution called *aqua causata* was made by boiling together arsenic, realgar, calcined tartar, sal ammoniac, with a ley of ashes and quicklime.

Zinc itself is not alluded to, but *lapis calaminaris* or *galmey*, native carbonate of zinc, and white vitriol are mentioned.

Of the acids, the only two that are distinctly specified are acetic acid and nitric acid. The latter was made by heating together saltpetre, alum, and vitriol.

Though sulphur was much used, there is no reference either to

the acid spirit or acid oil of sulphur—that is, sulphurous or sulphuric acid. Two kinds of oil of sulphur are described, one made by distilling linseed oil with sulphur, the other by digesting sulphur with oil of tartar—that is, with a strong solution of carbonate of potash, but these are oils in a very different sense of the term.

The list of saline substances is comparatively limited. Besides those already quoted, it includes common salt, which was subjected to an elaborate but very imperfect purification; tartar, calcined tartar, ashes, sal alkali, caustic potash, both solid and in solution, made by boiling ashes with quicklime, which in its turn was got by calcining egg shells when wanted particularly pure; sal ammoniac, alum, and an artificial substitute for borax, consisting of carbonate of potash and common salt, or of tartar and common salt.

B.—The processes are of a very rudimentary character, and relate mainly to gilding, silvering, tinning, and calcining the different metals, under which term was included, in pure ignorance of the different results, a good deal more than would be understood now, purification and refining of the metals and alteration of their appearance and properties, the separation or parting of the metals, the rendering of them more malleable, the formation of various solutions or waters as they were called, the preparation and purification of the salts and compounds above mentioned. There are besides some miscellaneous receipts. The very first receipt in the book is to make imitation amber. This was done by boiling turpentine and oil together till thick, stirring well, and pouring into a mould and exposing to the sun for eight days. Out of this could be cut Paternoster beads, knife handles, &c. Another method was to make a mixture of egg yolks, gum arabic, and cherry gum, and allow it to harden in the sun. It became transparent, and “when rubbed, it attracted straws like other amber.” According to another, gems were polished with powdered antimony (that is, the native sulphide) on a leaden sheet. A pyrophorus was made by heating a loadstone with sulphur very slowly up to incandescence, keeping it in that state for three days and nights, and then allowing it to cool. When moistened it burns. Imitation pearls were made from mussel and snail shells, thoroughly clean, powdered in a mortar, washed on a cloth in the sun, dried and calcined. The residue powdered, was added to pure white of egg and thoroughly stirred in, and then moulded “with carefully

washed hands" to the required size, a hole drilled through the pearls while still soft, which were afterwards dried in the sun. They were finally polished in red wine, and fair pearls were thus got. Scented pastilles were made with labdanum, storax, cinnamon, and other odoriferous substances mixed with charcoal powder, the whole converted into a paste with gum tragacanth and water, which was then moulded into pastilles with the hand. *Petroleum* was obtained by soaking bricks or tiles in oil and then distilling at a high temperature. These operations involved furnaces and vessels which are mentioned as things sufficiently well-known, and the operations themselves consisted in digesting with acetic acid and other menstrua, in crystallization, precipitation, sublimation, cupellation, cementation, roasting, fusion.

In no case is there any explanation of a process given—in no case does there appear to have been even a rudimentary conception of the rationale of it. On the contrary, the results were sometimes entirely misunderstood, substances or products were misnamed, and there was no notion of the permanence of the matter operated on, or of the constancy involved in the various changes. There is, for example, a process for "hardening mercury" which, assuming that the substances employed were the same as those denoted by the names now, and so far as the operations are intelligible, could not lead to the result supposed. A small hollow or depression is made in melted lead before it solidifies. Over this a cloth is placed, and then mercury on the cloth, and the whole is set in warm ashes till the "mercury" becomes hard. The "hardened mercury" is broken into pieces and placed in strong "vinegar," or in juice of the plant ox-tongue, vinegar, and oil, and boiled for a quarter of an hour. The "mercury" is mixed with sal ammoniac and vinegar in a luted vessel and left for 8 or 10 days; the "vinegar extracts all the roughness from the mercury;" the "mercury" is transferred to another vessel in a wind furnace, where it is heated gradually to redness till it detonates. The "mercury" is then hung in a pot with sulphur at the bottom of it, and a gentle heat is applied to vaporise the sulphur. This is to be repeated once a day for 30 days. The "mercury" is now removed, and can be hammered and fused. This "mercury," melted with twice its weight of copper, gives a product which behaves to all tests like genuine silver.

So far as one can see, the sole result of this curious operation, lasting five or six weeks, is to yield the lead that was begun with,

or sulphide of lead, while a quantity of mercury is sent up the chimney of the wind furnace.

Time and reiteration were important factors with the early chemists. Here is another example: "To make gold from mercury." A parting water (nitric acid) was made out of vitriol (sulphate of iron), saltpetre, and plumose alum, into which crude mercury was put. The "water" was distilled off and poured back again, or new "water" was added, and the whole was put in a long-necked flask to which a little alembic was well luted, with a receiver, and the water distilled away from the mercury by means of a gentle fire till the mercury became red like blood, and gave no fume when heated, "which will happen in three months" (!!)." "Test it for two or three months, the mercury will become fixed, reduce it quickly with borax or saltpetre and it will be changed into true gold."

Here, again, there is a consumption of three whole months, an endless amount of labour and expenditure of material to make what appears to be nothing more than red oxide of mercury. As for the transformation into true gold, that may have been due to the mercury containing some gold when used for the operation described, or it may not have been gold at all. It is almost useless to try to determine what the authors of these methods exactly intended, or whether the substances are the same as ours, or whether they were pure or not, or, in short, anything about the details. All the processes are quite empirical, and as the chemical properties of the substances employed were virtually unknown, they must have often neutralised each other's effects instead of contributing to the wished-for result. That, however, was inevitable in the then state of science; rather we may wonder that so much was known as seems to have been the case.

This collection forms the groundwork of the edition of 1537, and is contained in whole or in part in almost every one of the editions.

- 2.--1532. Kunstbüchlein. Allerley Mackel vnd Flecken aus gewand, Sammt (*sic*), Seiden, etc. zu bringen. Dazu auch wie einem jeglich Gewand seyn verlorne farb wider zu bringen sey, desgl. Garn und Leinwand zu farben etc. Nürnberg. d. Cunigund Hergotin 1532. in-4°. ($\frac{2}{3}$ th. Lempertz.)

This book is quoted by Graesse (*Trésor de Livres Rares*, Dresden, 1863, t. iv., p. 53), but I have not seen it. To judge from the title, it is quite different from No. 1; but it would be

interesting to know if it is the first, or an early edition of the tract with the same title, on the same topic, which is included, along with No. 1, in the 1537 and others of the later editions. That could only be settled by actual comparison of the contents.

It may be mentioned here that Graesse quotes other two tracts entitled *Kunstbüchlin*. One was printed at Erffort in 1599, the other, compiled by Heinr. Vogtherr, appeared at Strassburg in 1538. These tracts seem to be quite distinct from the series now under consideration. I have not seen them.

3.—1537. *Künstbüchlin, gerecht- | ten gründtlichen gebrauchs | aller kunstbaren Werckleüt. |*

Von	{	Ertzarbait, inn vnd ausserhalb feürs, außs Alchimistischem vnd natijrlichem grund, nemlich,
		Härten, Weychen.
		Schmeltzen, Schaiden.
		Abtreyben, Probiern.
		Löten Etzen.
		Abformen, Abgiessen &c.
		Jede farben zubereiten, erhalten, bessern vnd widerbringen, als zum
		Malen, Schreyben.
		Illuminiern, Vergulden.
		Sticken, Edelgestain &c.

Alles Jnhalt zu end beygelegten Registerlins.

M.D.XXXVII.

Small 4to, ff. xxxvii., and 1 of index. The vignette contains pictures of the instruments employed in the processes.

Colophon: Getruckt zu Augspurg, durch Heinrich Steyner, | am XVIII. tag Junij, im N.D.XXXVII. (*sic*) Jarr.

This book may be divided into two parts. Leaves 16 verso to 37 contain a simple reprint of the whole contents of the edition of 1531, No. 1, about which, therefore, there is nothing more to say. The preceding leaves, however, contain additional receipts, of which the following is a brief abstract:—

Leaves 2-6 are occupied with receipts for working with iron and steel. These metals were tempered by heating with horn shavings, or blood, or leather, the colour of the steel was noted, and degrees of temper were given to different tools by quenching in water, in infusions of plants, in tallow, in oil, in soap, and other substances.

The so-called solders were fusible mixtures of various kinds. One employed for joining iron in the cold was made up of sal ammoniac, common salt, calcined tartar, bell-metal, antimony,

all ground intimately together, and made into a paste with glue. This was heated very slowly to fusion, then, when cold, it was reduced to fine powder. The two pieces of iron, fitting as closely as possible, were fastened to a board, with paper below, the powder was laid on, and moistened with wine, in which *borras* (I presume the artificial mixture already referred to under No. 1) was dissolved; after the ensuing ebullition was over the action was complete, and the superfluous material was rubbed off. Supposing there was an action, it is not easy to see what part the different ingredients took in it. For copper, a solder was made of copper and white arsenic, and brass filings were also used.

Fluxes for ores were made of sandever, ashes, lime, pounded salt, tartar and saltpetre, all powdered together and thrown upon the ore. Another contained sulphur, lead, litharge, saltpetre, salt, sandever, all well powdered and mixed. These mixtures would undoubtedly slag or vitrify when heated.

Etching upon iron and steel was carried out by coating the surface of the object with wax, or with massicot or red lead and oil, cutting the pattern through the film, and then acting on the metal thus exposed with a water containing verdigris, mercury sublimate, vitriol and alum, or laying on mercury sublimate and moistening with strong vinegar. This seems to have been one of the ways for ornamenting armour.

Metal objects received a gold colour by being covered with yellow varnish. Copper was silvered by grinding intimately on a slab tartar, alum, salt, and silver leaf, adding water and dipping the copper in it, and then brushing with a scratch brush. Iron or steel was prepared for gilding by depositing copper on it from a mixture of verdigris and sal ammoniac.

Leaves 6-7 contain the receipts for taking spots and stains out of cloth. The title of this section corresponds exactly with that of the preceding work, No. 2; and I have little doubt that a portion, if not the whole, of that tract is incorporated in the edition of 1537.

The detergent employed was chiefly wood ashes causticized with slaked lime, and in this the stains were steeped and the fabric afterwards thoroughly rinsed with water and hung up in the air to dry. The operator is warned to keep coloured fabrics out of the sun, lest the colours fade; and among the receipts under this division is one for stiffening silk with gum.

The receipts about ink occupy leaves 8-10. The materials used

were nut galls, green vitriol, and gum water; but they were applied in a variety of ways, and, singularly enough, the importance of using proper proportions was insisted on as a preliminary instruction.

Invisible ink was procured by writing with vitriol and then washing with infusion of nut galls. Another plan was to write with white of an egg, wash ink over the whole surface, and then scrape with a knife where the writing was to be read.

Writing was obliterated by washing it with the distillate from a mixture of sal ammoniac and alum.

Leaves 10-16 contain the sections upon colours and their use. The colours were partly vegetable, partly mineral. Thus, a red colour, a lake, was got from Brazil wood, alum, and lime water, gum being added. A bronze colour was made from the same wood with *galitzenstein*, that is, native white vitriol. Yellow was made from saffron, and from the yolk of eggs. Green was obtained from buckthorn and alum; verdigris was used, and also a mixture of indigo and orpiment. What was called Greek green was merely verdigris. Blue colours were got from plants—the juice of elder berries with alum and lime water, of bilberries, of mulberries, and of corn flowers. A mixture of white lead and indigo was also used. The preparation of mosaic gold is given in tolerable detail; the materials employed were sal ammoniac, mercury, conterfey (a fine coloured brass) and sulphur. Another mixture was tin, bismuth, mercury, sal ammoniac, and sulphur. Mosaic silver was merely tin amalgam. An extraordinary method of getting a gold colour was to blow an egg, fill it with mercury rubbed up with egg-yolk, lute the holes and put the egg, along with half-a-dozen others, to be hatched!! At the end of three weeks the colour is ready.

Gold leaf was used. The metal was ground with honey and salt and put in a shell, then it was applied with gum water and burnished with a tooth.

Another way of applying metals was to write with finely powdered crystal or pumice and gum water, then rub on the metal till there was enough, and finally burnish. Several receipts of a similar kind are given.

The next section refers to the dyeing of horn, feathers, bone, parchment, and the methods were the same for all. Feathers, for example, were steeped in alum and then put into the colouring material. Yarn and cloth were dyed in the same way. Thus, to

dye a red, the cloth was limed and then steeped in Brazil-wood and alum; cinnabar also was used and lees of red wine, but no distinction is drawn between mordant and pigment colours.

The preceding, without exhausting the variations in the receipts, will give some notion of the substances employed and the processes pursued. Certain practical results were undoubtedly attained, but at a great expenditure of time and of material, and with an uncertainty inherent in every empirical process, in which what is essential and what non-essential to success are unavoidably confused. These receipts, however, were plainly considered of the very best and most authentic kind, and they are therefore well worth notice and consideration.

- 4.—1538. *Kunstbüchlein gerechten gründlichen Gebrauchs aller kunstbaren Werken. Von Ertzarbeyt etc. Härten, Weychen, Löten, Etzen, Abformen, Malen, Schreyben, Luminiren, Sticken etc. Augsp., H. Steyner 1538. in-4°. (38 ff.) Av. fig. en bois. (22 gr. Lempertz.)*

This is a second edition of the previous work, No. 3, 1537. The title is taken from Graesse, *Trésor de Livres Rares*, Dresden, 1863, t. iv., p. 53. See also No. 7, 1550. Graesse does not mention the previous edition.

- 5.—1539. *Alchimia. Wie man alle farben, wasser, olea, salia vnd alumina, damit man alle corpora, spiritus vnd calces preparirt, sublimirt vnd fixirt, machen sol. Vnd wie mann dise ding nutze, auff das Sol vnd Luna werden mög. Auch vom soluiren vnuud schaidung aller metal, Polirung aller handt edel gestain, fürtreflichen wassern zum etzen etc. ein kurtzer begrif. Strassb. Cammerlander, 1539. kl. 4. Mit Holzschn. Hlbldr.*

This title is taken from the *Antiquarischer Katalog* of C. H. Beck, Nördlingen, No. 165, 1885. The book itself I have not seen, but to judge from the title it is an early edition, perhaps the first, of the work that bears the name of Petrus Kertzenmacher. See No. 9, 1570; No. 12, 1574; No. 16, 1589; No. 21, 1613; No. 26, 1720, and No. 29.

- 6.—1549. **¶** Kunst Boeck. | Nyeulijck | wten Alchemistischen | gront vergadert, Tracterende | van allen grontlijkē gebruyc- | kinghen der cunsten. Nutlijck | voor allē wercluidē, als Munt | meesterē, Goltwerckerē, schey | deren, Goltsmiden, schilderen | eñ alle ander wercluydē, wer- | kende in stael, Yser, coeper, eñ | alle andere metalen. | **¶** Ghecolligeert eñ eensdeels | getraslateert, door Symonem | Andree van Aemstelredam. | ~~¶~~ Niemāt is hatende de cunst | dan die onwetenen. | 1549 | 16mo. Title, surrounded by a woodcut border with flowers, fruit, musical instruments, male and female *termini*, &c.; on the reverse is a

picture of a chemist in his laboratory. Besides the title-leaf, there are liij numbered leaves, and 5 leaves of contents.

The last leaf contains the device of the publisher: a hooded falcon perched on the branch of a withered tree, with the monogram Ck in the corner, and mottos on three sides.

The colophon is on the reverse of Hiij :

Geprent toe Campē, in die Broeder | straet by mi Stenen Joessen.
Anno. M.D.LI. | Voor Cornelis Karelsen, Woenende tot | Aemstel-
redam by sinte Oliis poorte int guldē | Missael. Voorstaēde op die
Nieuwebrugge | aent Paelhuysken. |

This is a translation into Dutch, with some modifications, of the German edition of 1537. It is divided into six tracts, and this is the first notable difference between the two, though the succession of the receipts is in reality the same. Another important difference is the omission in this edition of the sections referring to inks and colours (Ed. 1537, ff. 8-14), and of certain of the receipts for the tempering of iron, while some new ones have been added. The contents of the tracts are as follows:—

Tract I. treats of “iron, steel, and other materials, and how to harden, soften, and solder them, of etching on the same, of colouring, gilding, and silvering.” It begins: *Om yser hart te maken*, and it corresponds to ff. 2-6 in the 1537 edition, a few of the receipts being omitted, and one or two new ones added.

Tract II. contains receipts for “removing, by means of water or lye, stains or spots from cloth, velvet, silk, or other stuffs, whether of oil, fat, wine, or whatever it be, and that easily and without injury.” This includes ff. 6-7 of the 1537 edition, but a few receipts of the same character are added in the Dutch version. The first receipt is how to restore the colour to cloth: *Om laken sine verloren verwe weder te gheuen*.

Tract III. deals with the “colouring of wool and linen, the making of the colours, the colouring of horn and bone, the softening and moulding of horn.” The first receipt is to dye yarn or linen brown: *Om garen oft lijnwaet bruyn te verwen*; then follow more colour receipts, and those on bone and horn which occupy ff. 15-16 in the 1537 edition. This completes—as above-mentioned—the first section of the 1537 edition, which is succeeded by the reprint of that of 1531. The same thing occurs in the Dutch version, for towards the end of this third tract is found the receipt for “making a clear, fair amber,” *Agatsteen aerdich ende claer te maken*, as it is given in the 1531 edition (f. 3). This third tract contains at the end a few receipts, which do not occur in the

German versions, as to dyeing silk black, which was effected by boiling it for an hour in galls, and then putting it in a black colour made from gall-nuts and copperas, with rye meal, old iron, hammer scales; to dye silk and hoofs red by boiling in alum water, and then with madder; to dye yarn black by boiling pounded galls in water, taking the galls out and adding Roman copperas and a little gum arabic, and then dipping the yarn in the pot. The same mixture diluted with water was used for grey.

Tract IV. "teaches the gilding, silvering, and colouring of copper, iron, &c., how to fuse and cast them and make certain colours." This, which begins with the hardening of mercury, so that it may be hammered, cast, and worked, *Om Mercurium te arbeyden ende harden datmense smeen, gieten ende arbeyden mach*, corresponds with ff. 4-8 in the 1531, and with ff. 17-20 in the 1537 editions. One or two receipts are again added, such as to mend broken glass by a cement of red lead, quicklime, fine dust from a forge, white of egg, laid on with a cloth; to make *lutum sapientie*, a mixture of lime, horse-dung, iron filings, clay, white of egg, and salt water or ox blood. This was used for vessels which had to be heated to a high temperature, or for luting up subliming pots, and for similar purposes.

Tract V. relates "to the parting of gold, silver, copper, &c., and to testing them; useful and profitable for all goldsmiths, merchants, and others concerned therewith," and commences with the separation of gold and silver: *Om Golt te scheyden wt Syluer*, which is done by treating the conjoined metals with aquafortis at a gentle heat as long as bubbles escape. The fluid is poured into a copper dish on which the silver deposits. The gold which remains in the glass is collected and fused. A considerable variety of methods is given, and there are receipts for colouring metals so as to make them look like gold and silver. There is greater divergence from the earlier German editions in this tract than in any of the others, both in the way of addition, omission, and alteration of the order in which the receipts come.

Tract VI. repeats the title of the book, as it is concerned "with certain actions of Alchemistic things, to make gold and silver, and also with all calcinations of the planets [*i.e.*, the metals], to make waters and oils of the same, wherewith to produce wonderful effects." It begins with the making of gold from mercury, and follows almost exactly the order as given in the German editions. This tract is therefore a strict translation

of ff. 13-27 of the 1531, and of ff. 25-37 of the 1537 editions, with transpositions of certain receipts.

Of Andree, or Andriessen, as he is called in the later editions (Nos. 14, 19), I have failed to find any particulars. He has fulfilled his promise, for his miniature collection is mainly a selected translation from the German, which he has supplemented from other sources, or from his own experience. It may be observed, however, that in the receipts which he has translated he has introduced no modification or improvement. Such a thing, if thought of, was either kept as a special secret, or else it was given as a separate receipt or method.

7.—[1550 ?]. Kunstbüchlin, gerecht | ten gründtlichen gebrauchs aller | kunstbaren Werckleut. |

Von { Ertzarbeyt, in vñ ausserhalb feurs, auss Alchimistischem |
vnd natürlichen grund: nemlich,
Härten, Weychen.
Schmeltzen, Scheyden.
Abtreiben, Probirn.
Löten, Etzen.
Abformen, Abgiessen &c.
Jede farben zubereyten, erhalten,
bessern vnd widerbringen: als zum
Malen, Schreiben.
Illuminiren, Vergulden.
Sticken, Edelgesteyn &c.

¶ Alles Inhalt zu end beigelegten Registerlins.

¶ Zu Franckfurt am Meyn, bei Christian Egenolph.

Small 4to, ff. 37, and contents [1]. The vignette on the title is the same as that in the edition of 1537. There is no date or colophon.

This book is a word for word reissue of the edition of 1537, No. 3, but it is not nearly so nicely printed. I presume this is the edition referred to by Graesse, who, in a note to the *Kunstbüchlein*, 1538 (No. 4 above), says: "Il y en a une seconde éd. *Frckft. a. M., Chr. Egenolff* (vers 1550). in-4°. (1 th. R. Weigel)." Graesse, so far as I know, is the only writer who alludes to an undated edition of the book.

8.—1563. Ettliche Künste, | auff mancherley weisz Din- | ten vnd aller-
hand Farben zu bereytē. Auch | Gold vnd Sylber, sampt allen
Metallen ausz der | Feder zu schreiben, Mit vil andern nützlichen
künst | lein. Schreibfedern vnd Pergament mit al- | lerley farben zu
ferben. Auch wie man | Schrift vnd gemälde auf Stä- | helene,
Eisene waaffen vñ | dergleichen, etzen sol. | Etliche zugesetzte Kün-
stücklin, vormal | im druck nie ausgangen. | Allen Schreibern,

Brieffinalern, sampt | andern solcher Künsten Liebhabern, gantz |
lustig vnd fruchtbar zu wissen. | Den Inhalt dises Büchlins, vnd
was | für künst hierinn begriffen, findest du | anderseits dises Blats. |

Getruckt zu Straszburg bey | Christian

Müller, Im Iar | M. D. LXIII. |

Small Svo, signatures A—C, or ff. 24, not numbered.

This small volume consists of a reprint from the edition of 1537, No. 3, of the sections on inks, colours, etching, and cleaning of silk and other fabrics. To these are added one or two additional methods of making a red colour with Brazil wood, and methods of colouring horn, bone, glass, and a pretty full section on the dyeing of leather.

9.—1570. Alchimia, | Das ist, | Alle Far- | ben, Wasser, O- | lea, Salia,
vnd | Alvymina, damit mann alle Cor- | pora, Spiritvs vnnnd Cal- | ces
Prepariert, Sublimiert vnnd Fi- | xiert, zubereyten. Vnd wie mann
di- | se ding nütze, auff dasz Sol | vnd Lvnna werden | möge. Auch
von Soluieren vnnd schey- | dung aller Metall, Polierung allerhandt |
Edelgestein, fürtrefflichen Wassern zum Etzen, | scheyden vnnd
Soluieren. Vnd zuletzt wie die | giftige Dämpff zuuerhüten, ein
kur- | tzer bericht, &c. | Cum Gratia & Priuilegio Imperiali. | Zu
Franckfort am Meyn. | M. D. LXX. |

Small Svo, ff. 79 (misprinted 77), and a leaf of Contents. There are 9 pages occupied with woodcuts of different kinds of furnaces and distilling apparatus. In the text is a cut (repeated three times) of a man engaged in tending a furnace with a still, and one of a flask (repeated four times). The title is printed in red and black, and on the reverse is a list of Latin chemical words, with their meanings, copied from the 1531 edition.

Colophon :—Zu Franckfort am Meyn, Bey | Christian Egenolffs Erben. |

In this edition the word “Alchimia” is in black and the initial A of “Alle” is in red. This arrangement is reversed in the editions of 1574, 1589, 1613, but is resumed in that of 1720.

This edition is the only one mentioned by the Author of the *Beytrag zur Geschichte der höhern Chemie*, Leipzig, 1785, p. 577 ; by Gmelin, *Geschichte der Chemie*, Göttingen, 1797, I., p. 293 ; and by Schmieder, *Geschichte der Alchemie*, Halle, 1832, p. 280. Gmelin and Schmieder, however, have simply quoted the *Beytrag*.

Though I have been unable to compare them, I have no doubt that this is an edition of the book with the same title published in 1539, No. 5. No author's name is given, but there is a preface by a certain “Petrus Kertzenmacher, sometime burgher at Maintz, a renowned alchemist.” Who Kertzenmacher was does not appear ; Schmieder says that he is unknown. I have met

with no notice of him, and the name may be fictitious. In his preface he says that all art is from God, who imparts it to those who desire it of him. Men desire what is most of use to them; they therefore seek out strange crafts, but only for their own advantage, not for God's glory, and thus they but seldom succeed. Among the arts, "Alchimia" is the best and highest, for whoever has it overcomes everything. But it is very obscure, for the old masters of the art would not teach it to their children and friends. Happy, therefore, is he who finds it, for it is not soon found. Labour, however, conquers all things, and if one seeks right arts with diligence and earnestness it will not be in vain. In this art of Alchimia one must know the materials (which Kertzenmacher undertakes to describe), such as cinnabar, ultramarine, verdigris, white lead, green vitriol, alum, white vitriol, tartar, zinc white, calamine, orpiment, arsenicum, sulphur, sal ammoniac, saltpetre, sal alkali, sal preparatum, sal borax, and the seven metals—gold, silver, mercury, iron, tin, lead, and copper. He next points out that certain of the substances are called *bodies*, such as gold and silver, which are fixed when heated; while others are called *spirits*, such as sulphur, mercury, sal ammoniac, and arsenicum, which cannot abide the fire, but fly away. Whoever will have a true knowledge of the art must be able to make the spirits become bodies, so as to remain permanent in the fire. How this is to be done Kertzenmacher promises to teach, and he accordingly divides his treatise into two books, the first descriptive of the materials, the second of their use in transmutation.

To judge from the preface, Kertzenmacher claims—at all events he does not disclaim—the authorship of the work; but when we come to the first book we find it introduced by the following title:—

Rechter gebrauch der Alchimei, mit viel biszher verborgen, nutzbaren vnd lustigen Künsten, nit allein den Alchimisten, sonder allen Kunstbaren Werckleuten, auch sonst aller meniglich inn viel wege zugebrauchen.

—which is to all intents identical with that of 1531. Like the title, a considerable portion of the first book is taken from the 1531 edition, but there are some transpositions and variations and a few additions, such as the description of furnaces; while the receipts in the first edition, which were considered as not bearing upon transmutation, have been omitted. Kertzenmacher's work is therefore only a selection from the main series, but as

such I have considered it necessary to include it in the present list, especially as the compiler has seen fit to appropriate the original title. The receipts in this book relate to the substances above enumerated, and include the calcination of the metals, the preparation and purification of some salts, and the making of certain solutions or waters, which have been already alluded to under the first edition, 1531.

Book two deals with what was called transmutation, in reality the formation of white and yellow alloys and amalgams, or, in certain cases, of mixtures containing gold or silver. The few receipts on this subject which are to be found on ff. 17-19 of the 1531 edition are included, but the greater part of the book is either altogether new, or is taken from some other work with which I am unacquainted. The receipts are purely empirical, and much labour and time were spent in repeating over and over again such operations as solution, crystallization, sublimation, with the view of getting the materials into the proper state for the required action. As these operations were performed without any principle, the results expected were never attained at all, or, if they were, the same results could be got at now with vastly greater rapidity and sureness. In the sixteenth century, however, the knowledge was non-existent, and the experimenter could work only according to his lights, as has to be done at the present day.

The concluding operation of this book is the separation of gold and silver. *Aqua fortis* is poured into a glass with a long neck, which is set in ashes over a furnace and heated by a gentle fire. The alloy in small pieces is thrown into the flask, a condenser is adapted to it, and the whole is distilled to dryness. After the flask is cold the gold is found at the bottom, the silver adhering to the flask like crystal. On breaking the glass the two products are kept apart; each is melted with a little borax, and in this way good gold and silver are separated from one another. If all the receipts were as clearly described as this there would be little room for criticism, and considerable cause for surprise and admiration. (Compare No. 6, 1549, Tract V.)

Appended to Kertzenmacher's treatise is a reprint of the tract on the solution and parting of metals by Gilbertus Cardinal; on the polishing of precious stones; on excellent waters for etching, parting, and dissolving; on precautions to be taken against the poisonous vapours of metals. These tracts, so far as I know, first appeared along with the *Bergwerck vnd Probir büchlin*, printed by

Christian Egenolph at Franckfurt in 1533, in square 8vo, of 39 leaves. They are included in all the editions of Kertzenmacher's work subsequently quoted (No. 12, 1574; No. 16, 1589; No. 21, 1613; No. 26, 1720), but they do not form part of the present series of receipt books. The *Bergwerck vnd Probir büchlin*, however, is of special importance, as affording part of the proof that the same Egenolph was the printer of the *Rechter Gebrauch d'Alchimei*, 1531. See No. 1.

- 10.—1573. In the British Museum there is an edition of the Secrets of Alexis, in French, printed at Paris, in this year, by Hierosme de Marnef and Guillaume Cauellat, in a fat little 16mo of 911 pages, besides a long index of 80 pages. It was edited by Dr. Christofle Landré, who added to the original work of Alexis collections of secrets from other sources. One of these was the *Kunstboeck* of Andriessen, of which a translation in full is contained in pp. 760-846. Like it, the translation is divided into six tracts, which follow in the same order as in the Dutch.

The first tract treats of metals, and begins: *Pour endurcir le fer*.

The second: *Pour rendre à un drap sa couleur perduë*.

The third: *Pour teindre filet ou toille en brun*.

The fourth: *Pour preparer le Mercure*.

The fifth: *Pour separer l'or de l'argent*.

The sixth: *Pour faire or de Mercure*, and it ends: *Pour gradir l'or*.

In this French version there are a few minor differences; but Landré simply incorporated the whole contents of the 1549 edition in his collection of receipts. From the division of the translation into six sections, it must have been made either from the Dutch, or from some other similarly-arranged edition which I have not seen, and not from the German of 1537, which, as has been already pointed out, runs on without any formal sectional arrangement.

The remainder of Landré's work has nothing to do with the present series of receipt-books. For later reprints, see No. 13, 1576; No. 23, 1637; and No. 25, 1691.

- 11.—1574. *Kunstbüchlin*, | Gründtlichen | rechten gebrauches, | aller Kunstbaren Werckleut. Von | Ertzarbeyt, in vnd ausserhalb Feuwers, auss | Alchimistischem vñ natürlichem grunde, Nemlich: | Härten, Weychen, Schmelzen, Scheiden, Abtrei- | ben, Probirn, Löten, Etzen, Abformen, Abgiessen, &c. | Jede Farben zubereyten, erhalten, bessern, vñnd wi- | derbringen: Als zum Malen, Schreiben, Illu- | miniren, Vergulden, Sticken, | Edelgesteyn, &c. |

Alles Innhalt zu endt beygelegten Registers. |

Mit Röm. Key. Maie. Priuilegien. |

1574 |

Franckfort, Bey Chri. Ege. Erben. |

Small Svo, ff. 84, and Innhalt, ff. [3]. Title red and black. The vignette is a man cutting discs on an anvil with hammer and punch.

Colophon:—

Getruckt zu Franckfort | am Mayn, bey Christian Ege- | nolffs Erben,
In verlegung D. Ada- | mi Loniceri, M. Johannis Cnippij, vnd | Pauli
Steinmeyers, Jm jar | nach der Geburt Christi | vnsers Erlösers, |
M. D. LXXIII.

The title is from a copy in the British Museum [1033, c. 12 (3)]. This is a reprint of the 1537 edition, No. 3.

- 12.—1574. Alchimia, | Das ist, | Alle Far- | ben, Wasser, O- | lea, Salia,
vnnnd | Alvmina, damit man alle Cor- | pora, Spiritvs vnnnd Cal- | ces
Prepariert, Sublimiert vnnnd Fi- | xiert, zubereyten. Vnnnd wie man
di- | se ding nutze, auff das Sol | vnnnd Lvna werden | möge. | Auch
von Soluieren vnnnd schey- | dung aller Metall, Polierung allerhandt |
Edelgestein, fürtrefflichen Wassern zum Etzen, | scheyden vnnnd
Soluieren. Vnnnd zuletzt wie die | giftige Dämpff zuuerhüten, ein
kur- | tzer bericht, &c. |

Cum Gratia & Priuilegio Imperiali. |

Getruckt zu Franckfort am Mayn, |

M. D. LXXIII.

Small Svo, ff. 79, and Register f. [1]. Title red and black. Woodcuts of stills and furnaces.

Colophon:—

Getruckt zu Franckfurt | am Mayn, bey Christian Ege- | nolffs Erben,
In verlegung D. Adami | Loniceri, M. Johannis Cnippij, vnd Pauli |
Steinmeyers, Jm jar nach der | Geburt Christi vnsers | Erlösers, |
M. D. LXXIII.

The copy of this in the British Museum wants ff. 9-24; that in my own possession is perfect. It is a simple reprint of No. 9, 1570.

A third volume, uniform with this and the preceding, published in the same year, and with the same colophon, is the *Probier Büchlein auff Goldt, Silber, Ertz vnnnd Methal, mit vil köstlichen Alchimistischen Künsten*. This is the reprint of a treatise with an almost identical title, which appeared without place, date, or printer's name several years earlier. Though this 1574 reprint does not form one of the present series of books, it also is of importance, as furnishing evidence that the first edition of all, that of 1531, was printed by Egenolph. See No. 1.

- 13.—1576. Les Secrets Dy Seignevr Alexis Piemontois, Divisez En Devx Parties, . . . Avec La Troisieme Partie Des receptes de diuers autheurs, toutes bien experimentées & aprouuées: . . . Par Christofle Landré, . . .

A Paris, De l'Imprimerie de Hierosme de Marnef, & Guillaume Cauellat, . . . 1576.

32mo, pp. 911 ; Table, signatures MMM—QQQ viii (?)

This is a reprint of No. 10, 1573, and, as in it, pp. 760—846 of Part III. contain the translation of Andriessen's *Kunstboek*. The translation is divided into the six tracts, arranged in the same order as in the earlier edition and in the Dutch.

14.—1581. Een schoon Trac | taet van sommige werckin- | gen der Alchemistische dinghen, om | Gout, siluer te maken, ende oock van alle calcione- | ringhe der Planeten, ende andere Materien | waeteren ende olyen der seluer te maeken, | om wonderlicken daer mede te wercken. | Noch een Schoon Tractaet | Boecxken, Inholdende van alderley | verwen te maeken, ende ooc hoemen alderleye Ver- | wen wrijnen ende legghen sal, Ende is seer goetd | ende profijtelijsken, voor allen Schrijuers Schil- | ders, Conterfeyters, en andere Stoffier- | ders, Oock allen anderen Liefheb- | bers der Consten. Inholdende. | xxxiiij. Capittelen. | Ghecopuleert ende toesamen ghe- | bracht dorch Symon Andriessen, | van Aemstelredam |

Gedruckt toe Reess, By my Derick | Wijlicx van Santen. Anno. 1581. |

Small 8vo, ff. xxviii, numbered ; Tafel, 2 leaves not numbered ; “*Een schoon Tractaet van de Alchemistry*” 2 leaves, not numbered, at the end of which is the Colophon: Gedruckt toe Reess, By my Derick | Wylicks van Santen. | Anno. 1581. | It is printed in black letter.

This little volume contains two tracts. The first, beginning : “Eerst Goudt wt Mercurio te maeken,” and ending : “Hoemen dat Goudt gradiert,” corresponds with the sixth and last tract in the edition of 1549, No. 6, and therefore with the last half of the edition of 1531, No. 1, or with leaves 25-37 of the 1537 edition, No. 3. The second tract consists of a series of receipts, dealing chiefly with the preparation of colours for the use “scribes, painters, copyists, decorators, and other lovers of the arts.” Though it contains two or three of the receipts on colours which appear in the 1537 edition, No. 3, and in the third tract of that of 1549, No. 6, the order is different, and there are both omissions and large additions. The origin of these receipts I do not know ; they appear for the first time in this edition as forming part of this series of books. They are distinguished from the bulk of the other receipts by the very minutely detailed descriptions and by the precise nature of the preparations, and the directions given show what trouble the old artists took to have their substances in the best possible state. The first receipt is how to make

varnish for scribes. Egg shells, thoroughly clean and dry, were reduced to an impalpable powder by pounding and sifting, and then mixed most intimately with the finest white or yellow frankincense. This, when required, was dusted from a box with small holes, till the material got a smooth surface. Another mixture was oyster shells and rosin intimately mingled. This was cheaper, but it had the disadvantage of being brown. Scribes' chalk was made by pounding the best white dry chalk as fine as possible. White of egg whipt and filtered was mixed with milk, and this in successive portions was added to the chalk and the whole beaten and stirred till a perfectly smooth thin fluid was obtained. This was filtered through bags, and, after the fluid had passed through, the bags and the contents were allowed to dry spontaneously at an airy window for thirteen or fourteen weeks. Red ink, or, rather, a red paint, was made from finely powdered vermilion mixed by an elaborate process with white of egg. This was a general method for the utilisation of natural mineral colours: they were ground and sifted, or elutriated and dried—the operations being repeated as often as was deemed necessary,—and then the colour was used with gum water or white of egg. Green and blue colours from copper and white lead are mentioned.

Vegetable colours were extracted from flowers and from coloured woods, Brazil wood being frequently employed. This was boiled, strained, and treated with alum and lime, or with ammoniacal urine. A "lake" was formed, which was applied with gum water. Different shades were got by varying the proportions, or by mixing the colours.

A few artificial colours were made. Mosaic gold—*Aurum Musicum*—is very carefully described. Tin amalgam was heated with sulphur and sal ammoniac, the product thoroughly ground and used with gum water.

Gold was prepared for gilding by grinding the leaf gently for a long time in successive small quantities with salt and strong gum, made of the purest gum arabic and distilled or rose water. Much trouble was expended in getting the gold into the finest state. Several sections are devoted to the laying on of gold, the gilding of books, the colouring of parchment for receiving gold and silver writing, and other fine arts.

The directions give some insight, though not nearly enough, into the methods and materials of the old illuminators, whose

work seems to-day as brilliant as when it was first executed, and the results they attained show that work which is to be permanent must have much time and thought and labour expended in its production.

- 15.—1583. A profitable boke | declaring dyuers approued re- | medies, to take out spottes and staines, in Silkes, | Veluets, Linnen and Woollen | clothes. | With diuers colours how to die Vel- | vets and Silkes, Linnen and Woollen, Fustian | and Threade. | Also to dresse Leather, and to co- | lour Felles. How to Gylde, Graue, Sowder, and Ver- | nische. And to harden and make softe | Yron and Steele. | Very necessarie for all men, specialle for those | which hath or shall haue any doinges therein: with | a perfit table herevnto, to fynde all | thinges readye, not the like reuealed | in English hereto- | fore. | Taken Ovt Of Dvtche, | and englished by L. M. |

¶ Imprinted at London by Thomas | Purfoote, and William Pounsonbie. | 1583 |

Small 4to. Title leaf, and pp. 78. Table, pp. [6]. Printed in black letter.

The preceding is from the copy in the British Museum (C. 31, c. 18), and I presume it is the first edition of this translation. It was reprinted in 1596, No. 17, and again in 1605, No. 20, each succeeding edition being inferior to its predecessor. An account of the contents is given under No. 17, 1596.

- 16.—1589. Alchimia, | Das ist, | Alle Far- | ben, Wasser, | Olea, Salia, | vnnd Alvimina, | damit man alle Corpora, Spiri- | tvs vnnd Calces Prepariert, | Sublimieret vnnd Fixiert, zubereyten. | Vnd wie man diese ding nutze, auff | dass Sol vnd Lvnna wer- | den möge. | Auch von Soluieren vnnd | schey- | dung aller Metall, Polierung, allerhandt | Edelgestein, fürtrefflichen Wassern zum Etzen, | scheyden vnnd Soluieren. Vnnd zuletzt wie die | giftige Dämpff zuverhüten, ein kur- | tzer bericht, &c. | Cum Gratia & Priuilegio Imperiali. |

Getruckt zu Franckfort am Mayn, |

M.D. LXXXIX.

Small Svo, ff. 79 [1]. Pictures of furnaces, flasks, and other apparatus. The title is printed in red and black.

Colophon :—

Zu Franckfort am Meyn, Bey | Christian Egenolffs Erben. |

This is the fourth issue of Kertzenmacher's book. See Nos. 5, 1539; 9, 1570; 12, 1574; 21, 1613; 26, 1720; and 29.

- 17.—1596. A profitable booke | declaring dyuers approued re- | medies, to take out spotts and staines, | in Silkes, Veluets, Linnen, and | Wollen Clothes. | With diuers colours how to die Veluets | and Silkes, Linnen and woollen Fustian | and Threade. | Also to dresse Leather, and to colour Felles. | How to Gild, Graue, Sowder, and

Vernishe. | And to harden and make soft | Yron and Steele. |
 Very necessarie for all men, specially for those | which hath or shall
 haue any doings therein: with | a perfect table hereunto, to find all
 things | readie, not the likè reuealde in Eng- | lishe heretofore. |
 Taken Ovt Of Dytche, | and Englished by L. M. |

¶ Imprinted at London by Thomas | Purfoot, dwelling in the newe |
 Rents. 1596. |

Small 4to. Title leaf; pp. 78, numbered; Table, pp. 6, not numbered,
 followed by a blank leaf. Printed in black letter, except the title-
 page and the titles of the different receipts.

This edition, which is not in the Museum, is a simple reprint,
 on inferior paper and with less distinct type, of the edition of
 1583, contained in that collection, and already quoted, No. 15.

The treatise falls into two main parts: the first, pp. 1-58,
 contains receipts for taking out stains, for dyeing and colouring,
 and for dressing leather; the second, pp. 55-78, deals with iron
 and steel, etching on metals, gilding, and soldering.

The receipts for removing spots and stains are numerous, but
 they are mere modifications and variations of a general process,
 depending on the fabrics, and in a few instances on the kind of
 stains. Grease spots were removed by ashes, or oil of tartar, or a
 mixture of lime and ashes. "Walkers claye, called Fullars
 earth," is mentioned, and burnt alum mixed with soap. Ink and
 iron spots were treated with the juice of a lemon, or very sour
 orange, or crab apple, or with common salt and juice of an orange,
 or the boiling juice of sorrel. Oily spots in paper were got rid of
 by putting over them a layer of well burnt bone ash and pressing
 between two hard boards for eight-and-forty hours. A way to
 take wax and rosin spots out of cloth was to drop tallow on them,
 and then placing brown paper over the spots, to apply a hot iron
 till the rosin and tallow melted together and were absorbed by the
 paper.

Perfumes for clothes are described; and to keep away moths a
 powder of dried orange peel and elecampane root was recommended.

The receipts for dyeing are similar to those already so often
 quoted. The substances employed were woad, Brazil wood,
 "grening weede," indigo, oak bark, galls, verdigris, copperas, iron
 scales, alum, arsenic, ashes, and a solution of chalk in yinegar
 mixed with alum, which shows at how early a period acetate of
 alumina was in use. A considerable number of shades were
 obtained. All these receipts are very clear and exact. Skins
 were treated with lime and alum, and coloured with copperas,

madder, Brazil wood, and other substances; and a method of gilding leather is also given.

The contents of the second division are metallurgical. Numerous methods are described for softening and hardening iron and steel, some of which are to be found in the 1537 edition, No. 3. There are also receipts for soldering iron, varnishing it, preparing it for gilding, etching upon it. Most of these also have been already met with in the 1537 edition.

This work has been translated from Dutch and not from German; but, if it be not a compilation as well as a translation, I am not acquainted with any edition in either language of which this is an exact transcript. If the two divisions have been taken from different sources, the second would correspond with the first tract in the 1549 edition, No. 6, so far as it goes, for the English version is fuller; but there is nothing in any of the editions to correspond in extent and detail with the first division about cleansing and dyeing.* This confirms me in the belief that the present list does not exhaust all the extant variations of the series.

18.—1596. A | Booke of Secrets: | Shewing diuers waies to make and prepare all | sorts of Inke and Colours: as Blacke, White, | Blew, Greene, Red, Yellow, and other Colours. | Also to write with Gold and Siluer, or any kind of Metall | out of the Pen: with many other profitable secrets, | as to colour Quils and Parchment of | any colour: and to graue with | strong Water in Steele | and Iron. | Necessarie to be knowne of all Scriueners, Painters, | and others that delight in such Arts. Translated out of | Dutch into English, by W.P. |

Hereunto is annexed a little Treatise, | intituled, Instructions for ordering of Wines: | Shewing how to make Wine, That it may continue | good and faint not, Neither become sower, nor loose colour. And | how you may remedie faint Wine, take away the hoari- | nesse, with other instructions for the pre- | seruation of the same. | Written first in Italian, and now newly translated | into English, by W.P. |

London, | Printed, by Adam Islip for Edward | White, and are to be sold at his shop | at the little North dore of Pouls, | at the signe of the Gun. | 1596.

Small 4to. No pagination, but it contains ff. 19. Black letter.

The title of this rare pamphlet is from a copy in the British Museum. The first tract is a translation of the *Ettliche Künste*, No. 8, 1563, but it includes only the sections relative to inks and colours. Some of the methods for making colours, and all about

* It may be possibly a translation in full of the *Kunstbüchlein* of 1532, No. 2, which I have not seen, or of a Dutch version of it.

cleaning silk and dyeing leather have been omitted. The translator's name was W. Phillip.

The second tract has no connection with the other or with the present series.

19.—1600. Een schoon Trac- | taet van sommige werckingen | der Alchymistische dingen, om Gout, Sil- | ver ende oock van alle calcioneringe der Planeten, | ende andere Materien, Waterē ende Olyen der sel- | ver te maken. Item noch een Tractaet boecxken, | inhoudende van alderley Verwen te maecken, ende | oock hoemen alder leye Verwen wryven en leggen | sal. Ende is seer goet ende profytelijken voor al- | len Schryvers, Schilders, Conterfeyters en | andere Stoffiēders. Oock allen Lief- | hebbers der Consten. |

Noch een schoon Konst-boec, seer | nutlick voor allen Werclieden, als Munt- | meesteren, Goudtwerckers, Scheyderen, Goudt- | smeden, Schilderen ende allen Wercklieden, wer- | kende in Stael, Yser, Koper, ende alle ander Meta- | len. Item om alderhande plecken wt te doen. Om | alderhande coleuren te verwen. Van vergul- | dinghe ende versilveringhe. Ende van | werckinge der Alchymistissen | dinghen, etc. | Ghecopuleert ende te samen ghebracht | door Symon Andriessen van | Amstelredam. |

Ghedruckt t'Amstelredam, by Cornelis | Claessz opt Water int Schrijf-hoeck. | Anno 1600. |

Small 8vo. First book, ff. xxvj ; Second book, ff. xxvj. Contents, ff. [4]. It is printed in black letter.

This is a conjoined issue of the two preceding Dutch versions and it is in two books. Book I. is a reprint of the 1581 edition, No. 14, and it consists accordingly of two tracts. The first begins : "Eerst om Goudt wt Mercurio te maecken," and ends : "Hoemen dat Gout gradiert," and it is a reprint, therefore, of the sixth tract in the edition of 1549, No. 6. The second tract relates to the making and using of colours, of which, as has been already shown, the first appearance was in the 1581 edition.

The second book has a separate title-page as follows :—

Const-Boeck : | Nieulijck wt den | Alchymistischen gront vergadert. | Tracterende van alle grontlijcken | ghebruyckinghe der Consten. | Nutlijck voor allen Wercklieden, als | Muntmeesteren, Goudtwerckers, Scheyderen, | Goudtsmeden, Schilderē ende allen Wercklieden, | werckende in Stael, Yser, Koper ende alle ander | Metalen. Item om alderhande plecken wt te doen. | Om alderhande colueren te verwen. Van ver- | guldinge ende versilveringhe. Ende | van werckinge der Alche- | mistischen dingen, etc. |

Ghecolligeert ende eensdeels ghetranslateert, door | Symonem Andree van Amsterdam. |

Niemandt en haet die Konst, dan | die onwetende. | Ghedruckt, Anno 1600. |

This title is a reprint with two or three additions of that of 1549, No. 6, and this second book contains the first five tracts of that edition, the sixth tract having been put in the preceding book. It is a somewhat curious arrangement, and looks as if the compiler had had both the 1549 and 1581 editions before him, but instead of reprinting the 1549 copy as it stood, and making a seventh tract of the section of receipts about colours from the edition of 1581, printed off first the 1581 copy, and then added the remaining tracts from the earlier edition. The result of course is the same although the arrangement is inverted. This is the last edition in Dutch, so far as I know; if there were any later no mention of them and no examples have come under my notice.

20.—1605. A | Profitable | Booke, declaring diuers approp- | ued Remedies, to take out spots | and staines in Silkes, Veluets, Linnen | and Woollen Clothes: | With diuers Colours how to die | Veluets and Silkes, Linnen and Woollen, | Fustian and Thread: | Also to dresse Leather, and to colour | Felles. How to guild, graue, sowder, and ver- | nish. And to harden and make soft | Yron and Steele. | Verie necessarie for all men, specially for those | which haue or shall haue any doing therein: with | a perfect Table hereunto, to finde all things rea- | die, not the like reuealed in Eng- | lish heretofore. | Taken out of Dutch, and Englished by L.M. |

Imprinted at London by Thomas | Purfoot, dwelling within the new | Rents, in S. Nicholas Shambles. 1605. |

Small 4to. Title leaf, and pp. 78. Table, pp. [6]. Black letter.

The collation is from the copy in the British Museum, C. 31, c. 20.

This is another page for page reprint of No. 15, 1583, but it is as inferior to the 1596 edition as that is to the edition of 1583. The paper is very poor, the printing wretched. Deterioration, however, in the quality of successive reprints of a book seems, from the numerous instances which have come under my notice, to be the rule.

21.—1613. Alchimia, | Das ist, | Alle Farben, | Wasser, Olea, | Salia, vnd Alumina, damit man | alle Corpora, Spiritvs vnd | Calces Præparirt, Sublimirt vnd Fi- | xirt, zubereyten. Vnd wie man diese ding | nutze, auff dass Sol vnd Lv- | na werden möge. | Auch von Solviren vnd Scheidung | aller Metall, Polierung allerhand Edelgestein, für- | trefflichen Wassern zum Etzen, Scheiden vnd Sol- | viren: Vnd zuletzt wie die giftige Dämpff zu- | verhüten, ein kurtzer Bericht, &c. | Cum Gratia & Priuilegio Imp. |

Franckfurt am Mayn, in verlegung Vin- | centii Steinmeyers, Jm Jahr | MDCXIII.

Small 8vo, pp. 130; Index [3]; Colophon [1]; 2 blank. The title is printed in red and black, and pp. 7-15 are taken up with pictures of furnaces of various kinds. The colophon runs thus: Gedruckt zu Darmstatt, bey Bal- | thasar Hofmann, in verlegung Vin- | centii Steinmeyers: | Jm Jahr MDCXIII. | The device is an altar with fire upon it.

This is another reprint of Kertzenmacher's book, No. 9, 1570. See also No. 26, 1720.

- 22.—1616. Kunstbüchlein | auff mancherley weiss Din- | ten vnd aller handt Farben zu berey- | ten. Auch Goldt vnd Silber, sampt allen | Metallen auss der Federn zu schreiben, mit viel an- | dern nützlichen Künstlein Schreibfedern vnd Per- | gament, mit allerley Farben zu farben. Auch | wie man Schrift vnd Gemälde auff | Stäglene, Eisene Waffen, | vnd dergleichen | Etzen soll. | Etliche zugesetzte Kunststücklein, vor- | mals indruck nie aussgangen. | Allen Schreibern, Brieffmalern, | Sampt andern solcher Künsten Lieb- | habern, gantz lüstig vnd frucht- | bar zu wissen. |

Gedruckt zu Cöllen, Bey Peter von | Brachel, vnder der Gilden Wagen | Jm Jahr 1616.

16mo, or very small 8vo. Pp. 43. Inhalt, pp. [3]. Title red and black. Pagination very irregular.

Colophon:—

Gedruckt Cöllen bey Peter von | Von (*sic*) Brachel vnder der Gilden | Wagen. Jm Jahr 1616. |

There is a copy of this in the British Museum [1037, a. 10 (3)]. It is a reprint of the *Ettliche Künste*, No. 8, 1563, and is therefore composed of excerpts from the 1537 edition. Like the earlier issue of 1563, it contains the section on leather dyeing, but that upon removing spots and stains from silk, &c., is not included.

- 23.—1637. Les Secrets Dv Seignevr Alexis Piemontois. Reuen, et augmenté d'une infinité de rares Secrets. A Roven, chez Iean Berthelin, dans la Cour du Palais. M.DC.XXXVII.

Small 8vo, pp. 675; Table, 70.

This is a reprint of Landré's edition of 1573, No. 10, and accordingly it includes (pp. 564-631) the French translation of Andriessen's *Kunstboeck*, divided, as in the previous issues, into six tracts. It is a shabbily got-up book, badly printed on poor paper, and apparently meant for circulation as a chap-book.

- 24.—1687. Kunst-Büchlein, | Oder | Gründlicher Gebrauch von | Etz- Arbeit, in und ausserhalb | Feuers aus Alchymischen | und natür- lichen Grunde, | Nehmlich, | Härten, Weichen, Schmeltzen, | Scheiden, Abtreiben, Probieren, | Löten, Etzen, Abformen, | Abgiessen, &c. | Wie auch | Jede Farben zubereiten, erhal- | ten, bessern und wieder

bringen : | Als | Zum Mahlen, Schreiben, Illu- | miniren, Vergülden,
Stücken, | Edelgesteinen. | Nebenst beygefügtm Register. |

Franckfurth und Leipzig, | Verlegts Johann Caspar Meyer, | Anno
1687. |

24mo, pp. 203 ; index [9], 4 blank.

This is a reprint, in somewhat modernized language, of the edition of 1537, No. 3. It contains an additional paragraph on preparing a red colour from Brazil wood, corresponding to that in the *Ettliche Künste*, of 1563, No. 8.

25.—1691. In the British Museum there is another edition of the French translation of the Secrets of Alexis, printed at Rouen by “Jean-Baptiste Bensongne, ruë Ecuyere, vis-à-vis la petite rnë (*sic*) S. Jean, au Soleil Royal. M. DC. XCI.” in Svo. The translation of Andriessen’s *Kunstboeck* is contained in pp. 602-670, divided, as usual, into six tracts. It is a very scurvy volume, inaccurately printed, also in chap-book style, inferior even to the edition of 1637, No. 23.

26.—1720. Des berühmten | Alchimisten, | Petri Kertzenmachers, | Alchimia, | Das ist | Alle Farben, | Wasser, Olea, Salia und | Alumina, | Damit man alle Corpora Spiritus und | Calces præparirt, sublimirt, und fixirt, | zu bereiten, | Und wie man diese Dinge nutze, | Auf dasz Sol und Luna | werden möge, | Auch von Solviren und Scheidung aller | Metall, Polirung allerhand Edelgesteine, fürtreffli- | chen Wassern zum Etzen, Scheiden und | Solviren. | Dem noch beygefüget | Ein kurtzer Bericht, wie die giftigen | Dämpffe zu verhüten. | Anno 1720. |

Small Svo, pp. [2], 109; Index [3]. The title is printed in red and black.

This is a reprint of the edition of 1570, No. 9, and it tallies with those of later dates. The differences are in the insertion of Kertzenmacher’s name in the title-page, and in the omission from this edition of the short explanation of certain Latin technical words which are found in almost every version of these receipt books from that of 1531 downwards. The woodcuts of the different furnaces have also been omitted from the present issue.

27.—(15—?). In the British Museum [1036. a. 10 (4)] there is an earlier edition of the 1616 *Kunstbüchlein*, No. 22, or of the *Ettliche Künste*, No. 8, 1563. It is a small square 16mo, pp. I-XXXV, Inhalt, pp. [2], followed by a blank page. The title-page is wanting, so that I have been unable to ascertain the exact date: the colophon is as follows:—

† Gedruckt zu Augspurg durch | Hans Zimmerman. |

This little treatise contains, of course, the receipts on inks, gold and silver illuminating, colours, etching, &c., which are to be found in the 1537 edition.

- 28.— —? In the British Museum [1036. a. 10 (2)] there is an imperfect copy in square 16mo, of some earlier issue of the *Kunstbüchlein*, 1687, No. 24. The title is wanting, as well as about a dozen leaves at the end, so that nothing definite can be said about the date or place of printing. From its appearance, however, it was probably printed early in the 17th century, if not in the 16th. The fragment consists of ff. 2-76, and the contents correspond as far as they go with those in the aforesaid 1687 edition. Practically therefore this is a fragment of another edition of No. 3, 1537.
- 29.—Sæc. XVII. In a small 12mo volume I have a MS. on paper, of what is Kertzenmacher's treatise, although that person's name is nowhere mentioned. It contains 118 leaves numbered, and 1 not numbered. Comparison with the edition of 1570 shows that while it corresponds with the contents of that edition, it does not agree with it absolutely word for word. In some places, also, variations on certain of the processes are omitted, but practically the contents of the two volumes are identical. In the MS. version the tract by Gilbertus Cardinal on the solution of the metals is omitted, and instead of it are given a number of other receipts on the preparation of common salt, green and white vitriol, borax, sal ammoniac, tartar, verdigris, on gold, mercury, silver, arsenic, sulphur, marcasite, and other substances, some of which are to be found in the 1537 edition, while others do not occur in the printed copies so far as I have observed. The copyist has evidently thought it desirable to supplement Kertzenmacher's collection.

§ 3.—The results of this bibliographic sketch may now be summarised.

The first edition appeared in 1531. In 1532 was published the book about removing spots and stains from cloth, and these two were conjoined in the 1537 edition, certain other receipts about metals being prefixed. Kertzenmacher, in 1539, made a selection of the receipts specially relating to transmutation as he thought. In the Dutch translation of 1549 the matter was divided into six books; all about inks and colours was omitted; and the sixth book, relating to metallurgy, was enlarged. In the 1581 Dutch reprint of this sixth book a new tract on colours made its first appearance. Lastly, the English translation of 1583 added largely to the parts relating to cleaning and colouring. The remaining editions are either reprints or translations, in whole or in part, of the preceding types.

§ 4.—The mere enumeration, however, of these books, and recapitulation of the notions and methods of a long bygone chemistry which they preserve, would be of small value if some general principle were not illustrated by them as well.

One feature of them, which stands out strongly and strangely,

is their authors' ignorance or quite rudimentary conception of the properties of material objects. Substances were employed for a given purpose, apparently without certainty that they could produce the effect wanted, or, if they did, how the effect was produced. The receipts are empirical, and if they sometimes hit the mark it is more by chance than by good guiding.

That matter could be depended on, that a substance was individualised by its properties, seems hardly to have had any weight with the compilers of these receipts. They appear to have thought that the properties were variable, or could be extracted from a body, and so we meet with such a statement as that sal ammoniac *draws the colour out of copper*. From the way the author puts it, one feels in doubt if he knew the difference between gold and a yellow alloy. He certainly did not know that if gold is got out of mercury or lead, it must be there to begin with, and is not made by the process. There was no idea of combination or of chemical action as involving alteration of properties. Bewildered by changes to which he had no clue, with phenomena passing constantly before him which he could not control or produce at pleasure, the technical chemist fell back upon empirical trial, and so put a stop to progress. For empiricism is due to ignorance of the rationale of a process.

Wherever that ignorance exists a process must be imperfect; what is unessential is as likely to be included as what is indispensable, for there is no certainty about either one or the other. Hence in the receipts there are details which could have no bearing on the result, and operations are repeated with great expenditure of labour, time, and material, which, if they had been understood, would have been finished more speedily and economically.

§ 5.—So it happens that these books and their contents illustrate what I have said in the other paper* about the progress of the arts relying on mere practice, as compared with that based on inquiry into causes. The receipts give us insight partly into the manipulation of the old chemists and partly into the experience of others that they were the best to be got, and that the employment of them constituted the "right use of Alchemy"—something of *practical* use, as we hear about even now, as distinct from the examination of the phenomena and laws of nature. That these

* The paper meant is on *The First History of Chemistry*, read the same evening as the present one, and printed in the *Proceedings* for 1885-86, vol. xvii. See p. 222.

receipts were appreciated is evidenced by the demand for the books and the number of editions of them. Their persistence is one of their characteristics.

But if anything could illustrate the unsatisfactoriness of empirical methods it would be the contents of the books. For these practical receipts never got any further. They were reprinted *word for word* in 1687 as they had been set forth in 1531 and 1537, and in 1720 as in 1539 and 1570; that is, they existed and were repeated without even verbal change for 150 years.* The collections were varied by omissions or additions of receipts; but the retained receipts were not altered or improved. The science of chemistry had, meanwhile, gone past them, and other books, like those of Beguinus, Glaser, Glauber, of Becher and Stahl and Boerhaave, had been published, which threw new light upon chemical processes, and enabled them to be carried on in a more rational way, and, as a natural consequence, with ever so much better results.

If there were not constant evidence of the vitality of error, one might feel offended at what was considered a secret in practical art worth knowing at the beginning of the sixteenth century, being thought of equal value in the eighteenth, and being republished, unchanged, for the benefit of those who cared to use it. In our days a process can hardly continue for even a short time without its undergoing some modification. So widely diffused is the knowledge of natural science, so irresistible is the ambition to discover something unknown, so rapidly do theories change with new facts, so pressing is the demand for the application of discovery to human uses, that it would be impossible merely to reprint any work on pure or applied chemistry, even were it but two or three years old. It is difficult, therefore, to conceive the state of experimental science when a treatise of applied chemistry could still be of use 150 years after its first appearance. Such slow progression is hardly intelligible, unless we remember that there were receipts, trade secrets, jealously guarded, but no real science; no knowledge of the laws of nature which could be applied to make man's existence easier. Society besides had its attention directed in quite different directions, and was not fitted

* They, however, are not the only examples of literary longevity. Even more remarkable cases are described in my *Notes on Books of Secrets*, parts IV. and V., in the *Transactions of the Archæological Society of Glasgow*.

for the physical amenities of the present time. So far as chemistry was concerned its principles were too narrow and too inaccurate to permit of technical applications of them. The latter had to wait until the science had grown, by slow correction of its errors, to a fuller comprehension of its own scope. The history of technical chemistry shows that the only foundation for progress in practical applications and production lies in scientific investigation and in the employment of principles and laws; not in "rule of thumb," however absolute; not in haphazard discovery, however lucky and brilliant; not in mere practical dexterity, however consummate. Even if an epoch-making discovery be found by random search, its value is not understood until it has been brought under the law of its being. Priestley isolated oxygen, the most important of all bodies; but he was unable to deduce any law or generalisation from it, and to the end of his life he never grasped the significance of his own work; oxygen remained barren in his hands. Prussian blue, discovered by the merest accident, was manufactured empirically with the utmost uncertainty, until Scheele inquired into the cause of the blue colour, and demonstrated what substances are absolutely necessary for its production. Thereafter the manufacturer could proceed with rapidity and certainty. Coal tar, practically produced, was, as an utterly offensive product, practically wasted, until scientific investigation showed practice what can be done with it, what can be made of it. The coal tar industry, in its very widest form, rests on science, not on practice. Had not chemists pursued the examination of the substances in coal tar, merely for the sake of knowing them and without any intention of practical application, the coal tar colours would never have been discovered, and the series of manufactures thereon depending would never have been called into existence. Every industry that has truly progressed has acquired, sooner or later, to a greater or less extent, a scientific foundation. The history of the manufacture of sulphuric acid exhibits the economy of scientific working, as compared with that of mere practice.

No more hampering, no more fatal delusion can exist than that science is inimical to practice—that the manufacturer does not need science. If that has any meaning, it is that the producer on the large scale can get on better in his dealings with matter by ignorance of its laws than by knowledge of them; that he can afford to neglect them on the large scale, while the scientific investigator must obey them implicitly at any cost.

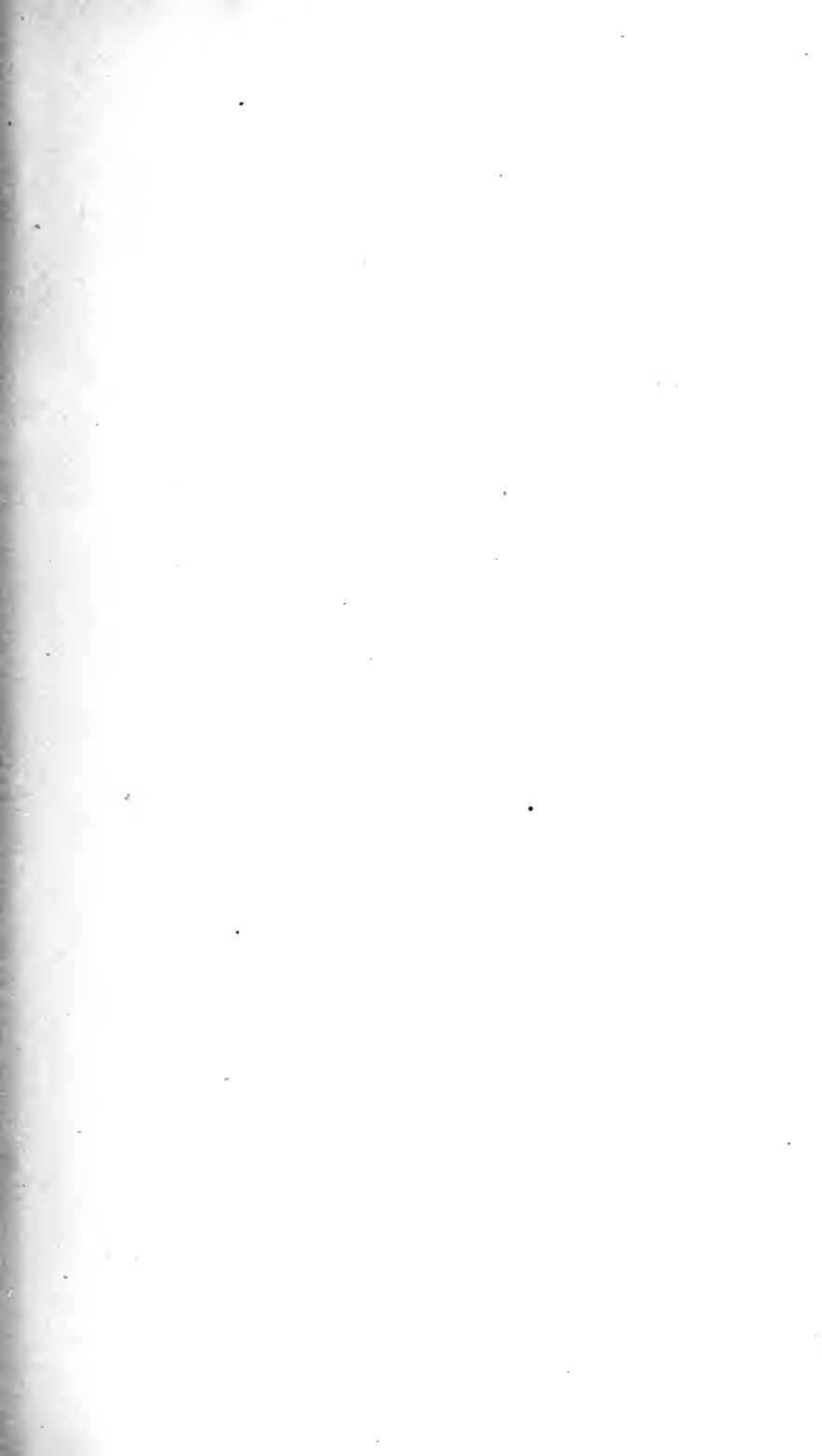
This is self-contradictory, and it is shown to be so by history. No thesis is easier to maintain or easier to illustrate than that the mere manufacturer is at the mercy of him who makes discovery his chief aim, and must follow wherever he leads. If it required anything to show how all-important is science to the progress of technology it would be the contemplation of the first attempts at technical or applied chemistry as recorded in these old books.

E R R A T A.

P. 14, l. 1. for dyeing, read dye.

P. 21, l. 32, after use, insert of.

P. 25. l. 12, for this, read it.



Z Ferguson, John
5524 Some early treatises on
A35F32 technological chemistry

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